The Impact of Green Bonds on Banking Sector Performance: A Comparative Study on Developed and Emerging Markets

Myvel Nabil[1]

Abstract

Green finance is a new trend in countries' future financial development, which has far-reaching significance for build resilience against the impacts of climate change and reduce greenhouse gas emissions. Whereas due to the importance of this issue, the financial institutions tend to use financial derivatives such as green credit and green bonds to help transform the economy to green.

Hence, this paper investigates the impact of green bonds on the banking sector annually from the 2013 up to 2021 for 14 countries, focusing on emerging and developed markets. Green bonds have been measured by log total value of green bonds and green bonds to GDP, while the performance of banking sector is measured by capital adequacy and profitability.

Using panel data, the findings indicate that there is a significant impact of the green bonds on banking sectors performance in certain markets. Overall, the results reveal the significant impact of green bond on the performance of banks' sector, most notably on the capital adequacy. This has to be more elaborated through further research to investigate the effect of green bonds on Stock market.

---

[1] Department of Business Administration, Faculty of Business, Ain Shams University. Cairo, Egypt.

1. Introduction

Climate change threatens communities and economies, and it poses risks for agriculture, food, and water supplies. Extreme weather events, hurricanes, and flooding are becoming increasingly more frequent, more destructive, and more costly. Consequently, climate change events cause damage to already climate vulnerable communities unable to recuperate fully before the subsequent debacle strikes.

This is especially vital as while global efforts attempt to adequately recover from impact of COVID-19, we must not forget that the world is facing an even more ominous challenge: the climate crisis. Although there is no evidence of a direct correlation between climate change and the pandemic, the former may affect the pandemic response as it puts further stress on health systems and undermines environmental determinants of health such as clean air, water and sanitation, and nutritious food.

As a result of face these challenges and implement Agenda 2030, realize the Sustainable Development Goals (SDGs), build resilience against the impacts of climate change and reduce greenhouse gas and carbon emissions, A lot of financing is needed to address these challenges. It's critical to connect environmental projects with capital markets and investors and channel capital towards sustainable development.

On this basis, green finance is suitable alternative, where plays an essential role to face the impacts of climate change. Green finance is a new trend in countries' future financial development, and is a rising global trend amongst financial institutions to use financial derivatives such as green credit and green bonds so, the financial institutions interest to issue these financial derivatives to transition to a sustainable low carbon economy.

The green credit is a long-term development strategy as it assigns further funds in order to transform to a sustainable low-carbon projects, it also makes perfect environmental benefits and enhances green development and market position, improves competitive ability, and has a positive effect on banks reputation. The green credit system involves two scopes which are: energy and its preserving, greening, sewer treating and carbon dioxide emission reduction. Despite of these advantages, these green credit enterprises are time-consuming, typically small in scale and uncertain, and face a specific loan risk Zhang (2018).

Notably, the green bonds are financial instruments that finance green projects with positive benefits for the environment, address the impacts of climate change and provide investors with regular or fixed income payments. In the last times, green bonds are furthest well known and one of the important and effective financing tools for achieving to the sustainable development and green financing (Zhang, 2018; Ning *et al.*, 2022).

Green bonds are one a way to make connect environmental projects with capital markets and investors and channel capital towards sustainable development. Consequently, the green bonds are growingly engaging interest at the technical,

regulatory, and academic research levels. Despite the increasing interest of research on green bonds, some of these researches focus on the investor's perspective. On the other hand, the green bond literature largely focuses on studying the link between green bond prices and financial markets.

To the best of my knowledge, there is no extensive literature to study whether these impacts of bonds are significant or not on banks sector performance in developed markets compared to emerging markets. Interestingly, this study takes the perspective of a financial impact and comparative aspect between markets.

The main purpose of this study is to investigate whether green bonds were more impact on banks sector performance in developed markets relative to emerging markets. In particular, this study empirically analyzes this impact by using annually data from the onset of 2013 up to 2021 for 14 countries: developed markets (France, Germany, Italy, Netherlands, Spain, U.S., and UK) and emerging markets (Brazil, Chile, China, India, Mexico, Turkey, and UAE). Green bonds have been measured by the value of green bonds, and the green bonds of GDP ratio, while the performance of banking sector is measured by capital adequacy, and profitability.

Using panel data, the findings suggest that the significant impact of green bonds on the performance of banks' sector, most notably on the capital adequacy. Consequently, the results of this study support the view that these bonds have the relatively significance impact on the performance of financial institutions, where the current study outcomes converse the results of Yeow and Ng (2021). But this study investigates the impact of green bonds on the banking sector from the 2013 up to 2021 for 14 countries, focusing on emerging and developed markets.

The rest of the paper is organized as follows. Section 2 presents the problem statement that is the focus of this study, Section 3 reviews research literature that has concerned with "green finance" and "the impact of green bonds". Section 4 illustrates the research hypotheses; Section 5 describes the data and variables of this study as well as the methodology used in the empirical analysis. Section 6 presents the empirical results and the discussion how these results answer research questions and provide a robustness check. Finally, Section 7 provides a conclusion and recommendation for future work.

2. The Problem Statement

More recently, the global financial crises, climate change and environmental concerns are a substantial challenge around the globe. To face these challenges such as mitigate the environmental pollution and ensure the stability and contribution of the financial sectors in transformation to green economies, a resolve such environmental issues through green financing are necessary Quirici (2018); Li *et al.* (2021); Alemzero *et al.* (2021); Iqbal *et al.* (2021); Devine and McCollum (2021); and Guo *et al.* (2022).

By previous literature that we show in section 3, Green finance is a new trend in countries' future financial development, which has far-reaching significance for build resilience against the impacts of climate change and reduce greenhouse gas

emissions. In the regard of the 2030 Agenda for Sustainable Development, this transformation will need further government efforts promoting the issuance of green bonds. It is, therefore, timely relevant to more examine this area, paying specific interest by the financial institutions to issue financial derivatives such as green credit and green bonds to help transform the economy to green Ning *et al.* (2022). Interestingly, some researcher's point out that these green financial products such as green credit and green bonds can potentially play an important role in reducing the environmental risks of the financial industry and improving it financial performance Zhang (2018); Song *et al.* (2019); Danye (2020); Alonso-Conde and Rojo-Suárez (2020); and Yasmin and Akhter (2021). In addition to, other studies attempt to studying the effect of green finance on carbon emissions reduction Guo *et al.* (2022).

In this context, these bond market have resulted in a wide range of impacts on financial performance. so, some studies focused on studying the impact of green bonds financing on the profitability, credit quality, environmental and financial performance, energy efficiency investment and economic growth Alonso-Conde and Rojo-Suárez (2020) Yeow and Ng (2021) Ning *et al.* (2022). Simultaneously, other research concentrated on analyzing the effects of green banking practices on financial performance Hossain *et al.* (2020). To the best of my knowledge, some little literature as regards banking sector has been interested in explaining it performance with green bonds.

Given the gaps in existing literature, this paper sets out to tackle an issue that remains largely unaddressed. The current study focuses on an understanding of the impact of green bonds on bank sector performance in emerging and developed markets. Also, the researcher tries the interpretation of the impact the value of green bonds and the different percent of green bonds to GDP during from 2013 to 2021. The following graphs that show this value of green bonds and the different percent of green bonds to GDP in emerging and developed markets, as shown in figure 1 & 2:
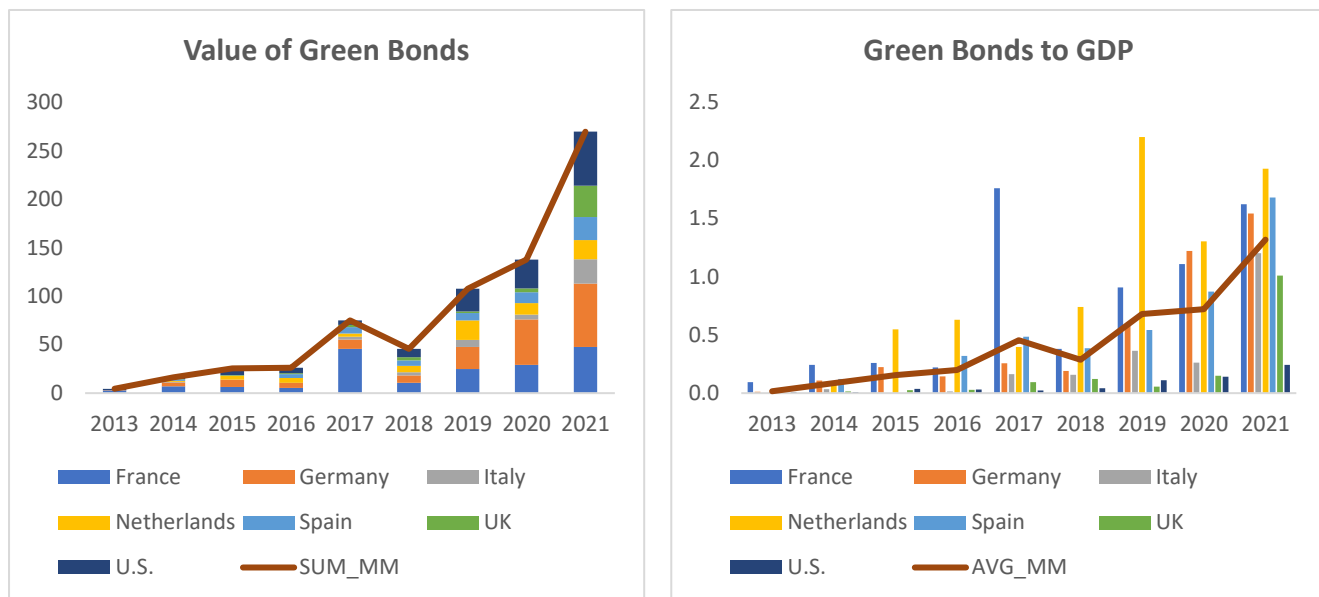
Figure 1: Development of Green Bonds in Developed Markets
Source: Prepared by Researcher

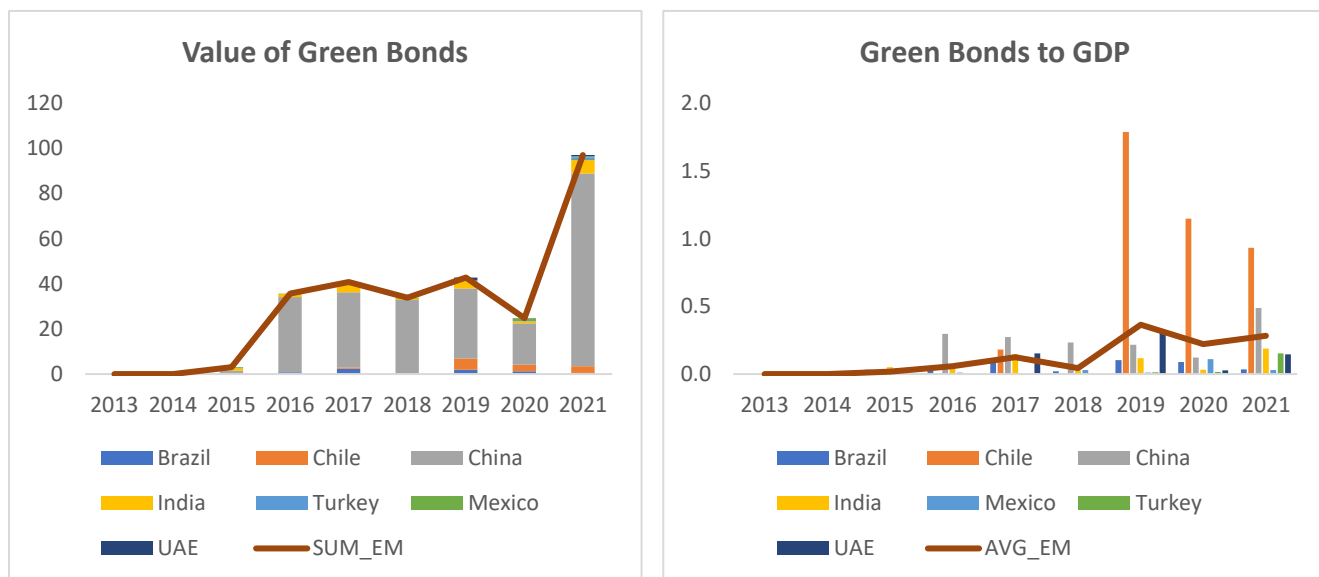**Figure 2: Development of Green Bonds in Emerging Markets**
Source: Prepared by Researcher.

This becomes evident that many countries have green bonds by different values from 2013 to 2021. It shows that, the countries are endeavor for green environment and better future by financing via green bonds. As far as we known, the literature presented little evidence of this issue. This study has selected comparison between

emerging and developed markets. Emerging markets have comparatively limited resources to deal with the impacts of the epidemic and thus are foreseen to suffer worst.

In this regard, the banking industry is one of the major industries in markets, especially Emerging markets so understanding how the banks' sector performance reacts to green bonds impact is very important for investors and financial analysts to assert can support the idea of considering investments in green bonds may be positive impact on banking sector. Therefore, this study focuses on banking sector for 14 countries in developed and emerging markets during the period from 2013 up to 2021.

This paper empirically investigates the impact of green bonds as measured by LOG value of green bonds and green bonds to GDP ratio on banks' sector performance as measured by Capital Adequacy, and Profitability during the period from 2013 to 2021 for 14 countries in emerging and developed markets. In brief, this paper tries to answer the following questions:

- Do green bonds affect banking sector performance?

Overall, the sample includes 126 observations in 14 countries, using control variables, which included macroeconomic variables (e.g., GDP real growth rate, General gov net balance of GDP ratio, and inflation rate).

3. Literature Review

This section tries to present some of the previous work that has been conducted in two fields: 1) green finance and the financial derivatives which support transform the economy to green and 2) the impact of green bonds.

Interestingly, some researcher's point out that the green financial products which support transition to the economy to green such as green credit and green bonds can potentially play an important role in reducing the environmental risks of the banking industry and improving it financial performance Alonso-Conde and Rojo-Suárez (2020).

Regarding green finance and the financial derivatives which support transform the economy to green, the following studies attempt to analyze the impact of green credit on financial performance Zhang (2018); Song *et al.* (2019); Danye (2020); and Yasmin and Akhter (2021). Other studies attempt to demonstrate variation in carbon emissions and the effect of green finance on carbon emissions reduction Guo *et al.* (2022).

Specifically, the following outcomes which regard to the impact of green credit are drawn from the experiential studies of Zhang (2018); Song *et al.* (2019); Danye (2020); and Yasmin and Akhter (2021). In the Previous researches on the impact of green credit on the financial performance, most authors found that green credit will increase the cost of operations in the short term and affect the growth of profits. Conversely, other authors expect a positive effect in the long run profits after application of green credit policy.

In this context, Zhang (2018) analyzes the impact of commercial bank green credit

on financial performance by taking industrial bank in China as a case and using its financial data from the period of 2005 to 2017. The results of this study find that green credit has a positive impact on bank's financial performance. In addition to, this study indicates that green credit has an important impact on net profit, as observe the profit growth ratio went slow in the period of 2013 to 2015 because of some of environmental and financial factors. Consequently, these results support the previous view of Song *et al.* (2019).

As highlighted by Song *et al.* (2019), the ratio of green credit is conversely related to the profitability of Chinese commercial banks, while Zerbib (2019) investigates the impact of non-monetary motivations on bond market prices, using a matching way for bonds issued from 2013 to 2017, followed by a twostep regression proceeding, to appreciate the yield differential between a green bond and a counterfactual traditional bond during this period. The results confirm the depressed effect of investors' pro-environment favorites on bond rates.

In that vein, Danye (2020) assures the positive impact of green credit on the profitability of China's commercial banks. Similarly, Yasmin and Akhter (2021) suggests that green credit has a positive impact on bank profitability in Bangladesh. Yin and Wang (2022) constructs 12 portfolios based on several factors such as: market, scale, book-to-market and green, using the sample of data for listed corporates in Shanghai and Shenzhen markets from 2005 to 2017. The results present all agents have high explanation power for the premium anomalies of China's green concept stocks, as a result of the effect of the application of national plans.

Additionally, Guo *et al.* (2022) address what and how green finance impacts on carbon emissions reduction of the 11 districts or cities in the Yangtze River Economic Belt in China over the period from 2006 to 2019. The authors examine the relationship between green finance and carbon emissions from the perspective of mediation and spillover effects. To accomplish this, they use the technological innovation as a mediating variable and depend on the control variables such as: industrial structure, urbanization rate, and the opening up level. Guo *et al.* (2022) found evidence that the green finance has a prominent adverse direct impact on carbon emission, but the spillover effect of green finance on neighboring provinces are seemingly insignificant. Tomfort (2023) suggests several methods to make green bonds extra effectual, including: execute a disagio in the major repayable if the investment has resulted in decrease in greenhouse gas emissions. In addition to, Tomfort (2023) indicates that another method is support for asset-backed and guaranteed bonds, and an identification the criteria for a green bond to promote the confidence of investors in this bond market portion.

Regarding the impact of the green bonds, the following studies attempt to explain the impact of green bond financing on the environmental projects, profitability, credit quality, environmental and financial performance, energy efficiency investment and economic growth Quirici (2018); Alonso-Conde and Rojo-Suárez (2020); Yeow and Ng (2021); and Ning *et al.* (2022).

These researches have indicated that the green bond' proceeds aim to finance green

or environmental projects Quirici (2018). Simultaneously, other research concentrated on studying green bond financing gives financial incentives for sponsors and provides higher returns for shareholders compared to conventional financing Alonso-Conde and Rojo-Suárez (2020). In addition to, some studies focused on the impact of role of green bond on environmental and financial performance, energy efficiency investment and economic growth Yeow and Ng (2021) and Ning *et al.* (2022).

Quirici (2018) suggests that green Bonds are substantial for the providing a new opportunity to investors and are one of the most substantial tools of impact investment. These chances aligned with the Sustainable Development Goals (SDGs) and, at the same time, the green bonds can be deemed as a bridge to achieve these goals. Quirici (2018) shows that the green bonds' proceeds are specially aimed at finance green or environmental projects. This study indicates that there a significant problem for investors is existing a different way of assessing the bond greenness, so that the investors find uncertainty to classify if a project is climate-friendly or not.

Alonso-Conde and Rojo-Suárez (2020) examines that the impact of green bond financing on the profitability and credit quality and analyze whether there is a direct financial incentive for financing via green bonds issuance. To accomplish this, the authors study and develop the case of regasification plant of Sagunto (Spain) by using annual data of financial statements from January 2011 to December 2018 and forecast for subsequent years from 2019 to 2041 by different assumptions consistent with financial data for the case that were studied.

Their results reveal that green bond financing yields financial incentives for sponsors and provides higher returns for shareholders compared to conventional financing. in addition to, the results of their study support the view that scenario analysis can be a useful tool for sponsors to entirely design the debt structure relevant to the project. Regarding sustainable development and green environmental protection, more banking financial institutions seemed to transform into green development and innovate green financial products.

Additionally, Yeow and Ng (2021) investigates the effectuality of green bonds in improving firm environmental performing and influencing corporate financial performance. This study focuses on both the profitability and operational efficiency by using data from conventional bond and green bond issues from 2015 to 2019. The findings indicate that certified green bonds are effective in improving environmental performance. Furthermore, green bonds do not have an influence on financial performance.

Ning *et al.* (2022) demonstrates the green finance notion from the perspective of energy economy and endeavor to solve the barriers associating with the notion. The authors focus on the impact of role of green bond financing on energy efficiency investment and economic growth by using fuzzy decision-making modeling technique. In addition to, the authors developed the green growth index (GGI) by using a sample of South Asia countries and used radial distance function (DDF) approach to test the relation. This study points out that the main source of financing

for energy competency projects is bank loans presently. The results revealed that the significant of effectively implement to suggested policy towards to foster scope the role of green bond financing, which has a positive impact to lift energy efficiency financing and green growth.

In view of the contradictory and insufficient views regarding the impact of green bonds on financial performance, there is still a need to study green bonds' impact on financial performance in banking. Therefore, this study attempts to fill this research gap by analyzing whether green bonds are more impact on banks sector performance in developed markets relative to emerging markets. In particular, this study empirically analyzes this impact by using annually data from the onset of 2013 up to 2021 for 14 countries: developed markets (France, Germany, Italy, Netherlands, Spain, U.S., and UK) and emerging markets (Brazil, Chile, China, India, Mexico, Turkey, and UAE).

4. Research Hypotheses

According to the literature review and problem statement discussed above, this paper aims at testing the following hypothesis: The performance of banking sector is significantly driven by green bonds in developed and emerging markets.
Hypothesis testing criteria:

H_{O1}: There is no significant effect of green bonds for developed and emerging markets on Capital Adequacy.

H_{A1}: There is a significant effect of green bonds for developed and emerging markets on Capital Adequacy.

H_{O2}: There is no significant effect of green bonds for developed and emerging markets on Profitability.

H_{A2}: There is a significant effect of green bonds for developed and emerging markets on Profitability.

5. Research Methodology

5.1   Research sample and method

To examine the impact of green bonds on banking sector, our developed and emerging markets analysis includes the following 14 counties: developed markets (France, Germany, Italy, Netherlands, Spain, U.S., and UK) and emerging markets (Brazil, Chile, China, India, Mexico, Turkey, and UAE).

The above countries are chosen as the most representative developed and emerging markets according to data availability. This study depends on annual data (covering the period from 2013 to December 2021) for green bonds, bank sectors' performance, and control variables. This data was collected from the Institute of International Finance (IIF) and the International Monetary Fund (IMF). Overall, our

sample included 126 observations in 14 countries. This paper used quantitative methods using data panel time series (data panel), and the ordinary least squares method (OLS) to test the regression model.

5.2   Research variables
5.2.1   Green Bonds
To examine the impact of green bonds in developed and emerging markets annually during the period from 2013 through 2021, the researcher uses the LOG total value of green bonds, and the green bonds to GDP ratio as a measure of green bonds.
This study contributes to investigate the impact of the green bonds which is different from previous literature in two aspects: (1) this study measured green bonds for 14 countries and conduct a comparison between developed and emerging markets; and (2) this current study measured its impact on banking sector for 14 countries.

5.2.2   Banks' Sector Performance
This paper empirically investigates the impact of green bonds on banks' sector performance as measured by Capital Adequacy Ratio (CAR), Profitability during 2013 to 2021 for 14 countries in developed and emerging markets. So developed markets included as follow: France, Germany, Italy, Netherlands, Spain, U.S., and UK, while emerging markets: Brazil, Chile, China, India, Mexico, Turkey, and UAE.

5.2.3   Control variables
Banks play a vital role in many operations in the economies. On the other hand, the macroeconomic variables are reflecting the economic environment that affects the performance of banks sector. Therefore, this study considered three control variables, which included macroeconomic variables (e.g., GDP real growth rate, gov net balance of GDP ratio, and inflation).

Table 1: Description of variables used for testing hypotheses

Type	Variable	Abbreviation
Independent	LOG total value of green bonds	Ln-GB
	Green bonds of GDP ratio	GB_GDP
Dependent	Regulatory Capital to Risk-Weighted Assets	CAR
	Regulatory Tier 1 Capital to Risk-Weighted Assets	T1CAR
	Interest Margin to Gross Income	NIM_GI
Control	General gov net balance of GDP ratio	GGNB_GDP
	GDP real growth rate	GDPR
	Inflation rate	Inf.

Source: Prepared by Researcher

5.3   Research model

The model and approach used in this study were found in the established existing literature. four basic core panel OLS regression equation models were, then, proposed:

Using Panel Regression Model [2] typically, the data set has cross-sectional observations among different banks sector and re-sampled at a certain period of time for each country, so a panel regression will be most applicable to represent such a linear relationship through four main equations for forecasting Capital Adequacy, and Profitability, and can written as follows:

$$\widehat{Capital\ Adequacy\ Ratio}_{it} = Constant + \beta_1 \text{LOGGB}_{it} + \beta_2 \text{GB\_GDP}_{it} + \beta_3 control\ varibles_t + \beta_4 \text{France}_t + \beta_5 \text{Germany}_t + \beta_6 \text{Italy}_t + \beta_7 \text{Netherlands}_t + \beta_8 \text{Spain}_t + \beta_9 \text{U.S.}_t + \beta_{10} \text{UK}_t + \varepsilon_{it} \qquad (1)$$

$$\widehat{Profitability}_{it} = Constant + \beta_1 \text{GB}_{it} + \beta_2 \text{GB\_GDP}_{it} + \beta_3 control\ varibles_t + \beta_4 \text{France}_t + \beta_5 \text{Germany}_t + \beta_6 \text{Italy}_t + \beta_7 \text{Netherlands}_t + \beta_8 \text{Spain}_t + \beta_9 \text{U.S.}_t + \beta_{10} \text{UK}_t + \varepsilon_{it} \qquad (2)$$

$$\widehat{Capital\ Adequacy\ Ratio}_{it} = Constant + \beta_1 \text{GB}_{it} + \beta_2 \text{GB\_GDP}_{it} + \beta_3 control\ varibles_t + \beta_4 \text{Brazil}_t + \beta_5 \text{Chile}_t + \beta_6 \text{China}_t + \beta_7 \text{India}_t + \beta_8 \text{Mexico}_t + \beta_9 \text{Turkey}_t + \beta_{10} \text{UAE}_t + \varepsilon_{it} \qquad (3)$$

---

[2] The Panel Regression depends on Pooled OLS Regression Model and Fixed Effect Regression Model and comparing between them for the beat fitted model using F-test.

$\text{Profitability}_{it} = Constant + \beta_1 \text{GB}_{it} + \beta_2 \text{GB\_GDP}_{it} + +\beta_3 control\ varibles_t +$
$\beta_4 \text{Brazil}_t + \beta_5 \text{Chile}_t + \beta_6 \text{China}_t + \beta_7 \text{India}_t + \beta_8 \text{Mexico}_t + \beta_9 \text{Turkey}_t +$
$\beta_{10} \text{UAE}_t + \varepsilon_{it}$ (4)

Where: $\widehat{Capital\ Adequacy\ Ratio}_{it}$, and $\widehat{Profitability}_{it}$, refer, respectively, to the Capital Adequacy Ratio, and Profitability Ratio of bank sector i on year t. LOG GB_{it} denotes the LOG value of the year green bonds. i refers to a certain bank sector in each country. i is the bank sector number in a certain country, but t refers to a certain year from 2013 to 2021. GB_GDP_{it} refers to the green bonds of GDP ratio. GGNB_GDP_t is the general gov net balance of GDP ratio, while GDPR_t and Inf._t denote a GDP real growth rate and a country's inflation rate, respectively.

6. Empirical Results and Discussion

A descriptive statistic is used in this study to describe the object under study through data samples that have been processed by statistical test tools. The results of the descriptive statistical test are shown in tables 2 and 3.

6.1   Descriptive Statistics analysis

Table 2: Descriptive Statistics for emerging markets

Variable	N	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
CAR	63	15.57404	15.57299	12.18947	19.26389	1.997964	-0.011558	1.827005	3.613188
T1CAR	63	13.17805	13.28205	9.275427	17.25027	2.225862	0.012001	1.925434	3.032581
NIM_GI	63	69.98822	69.40566	60.83805	80.19297	4.981967	0.247176	2.189792	2.364657
GB	63	4.412805	0.377140	0.000000	85.30267	13.16624	4.399610	24.74967	1444.995
GB_GDP	63	0.123835	0.025898	0.000000	1.788001	0.291357	4.084584	20.97854	1023.654
GDPR	63	3.318079	3.061000	-8.167000	11.69000	4.132817	-0.685101	3.598065	5.867224
GGNB_GDP	63	-4.124857	-3.707000	-13.33200	8.395000	3.595943	0.071825	4.653523	7.231279
INF	63	4.782175	3.733000	-2.074000	19.59600	3.933868	1.559649	6.169975	51.91925

Source: Outputs of data processing using EViews 10

Table 3: Descriptive Statistics for developed markets

Variable	N	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
CAR	63	17.82351	17.96000	13.27929	22.87453	2.808571	0.170418	1.927523	3.324236
T1CAR	63	15.21844	15.17833	10.55299	19.29162	2.197585	0.085772	2.167109	1.898231
NIM_GI	63	56.23799	57.90337	32.89117	82.78626	12.77526	-0.123196	2.047949	2.538663
GB	63	11.24001	5.473067	0.000000	65.23474	14.87418	1.902944	6.031288	62.14294
GB_GDP	63	0.435960	0.189496	0.000000	2.201513	0.560898	1.531383	4.327884	29.25251
GDPR	63	1.160190	1.842000	-10.82300	7.441000	3.466059	-1.651306	6.485674	60.52508
GGNB_GDP	63	-3.781508	-3.532000	-14.49200	2.346000	3.459631	-0.686938	3.896953	7.066655
INF	63	1.269079	1.267000	-0.500000	4.685000	1.039126	0.574681	3.347634	3.784945

Source: Outputs of data processing using EViews 10

Between 2013 and 2021, tables 2 and 3 summarize the descriptive statistics of all variables for developed and emerging markets, respectively. As shown from the tables above, all variables are asymmetrical. Especially, table 2 shows skewness is positive for all variables except for regulatory capital to risk-weighted assets and GDP real growth rate. Meanwhile, table 3 presents skewness is positive for all variables except for interest margin to gross income, GDP real growth rate, and general gov net balance of GDP ratio.

6.2 The Panel Regression Results and hypotheses testing

To investigate impact of green bonds, this study used $logGB_{it}$ and GB_GDP_{it}, respectively. A panel regression model provides the following results:

Table 4: Effect of green bonds on banks' sector in Emerging and Developed Markets

Variables / The effect of dependent variable	Model 1 Emerging Markets			Model 2 Developed Markets		
	CAR	T1CAR	NIM_GI	CAR	T1CAR	NIM_GI
Constant	14.60678	12.71400	69.66565	16.32121	13.52617	57.31214
	(0.746937) ***	(0.379334) ***	(1.781579) ***	(0.751749) ***	(0.570665) ***	(1.571828) ***
LOGGB	1.267315	1.456638	0.296441	2.234228	2.434094	-0.399058
	(0.401741) ***	(0.467806) ***	(1.446488)	(0.615666) ***	(0.531332) ***	(2.402798)
GB_GDP	-0.483045	-0.705335	0.982247	0.774280	0.404850	-5.576461
	(0.487757)	(0.565609)	(1.771044)	(0.548010)	(0.471719)	(2.152313) **
GDPR	-0.066462	-0.088668	-0.132025	-0.101328	-0.107249	0.350408
	(0.033451) *	(0.038755) **	(0.121708)	(0.057579) *	(0.050033) **	(0.221407)
GGNB_GDP	-0.043686	-0.042892	0.221073	0.121361	0.097139	-0.436106
	(0.049831)	(0.058118)	(0.178773)	(0.070263) *	(0.060426)	(0.276555)
INF	0.141508	0.045926	0.305199	-0.056250	0.025818	-0.295455
	(0.047349) ***	(0.055671)	(0.167309) *	(0.190569)	(0.165815)	(0.730231)
R-squared	0.349672	0.860873	0.068050	0.500182	0.561289	0.896792
Adjusted R-squared	0.292625	0.830865	-0.013700	0.456338	0.522806	0.874532
S.E. of regression	0.809554	0.915408	3.058928	1.250171	1.090205	4.525187
F-statistic	6.129609	28.68830	0.832422	11.40830	14.58522	40.28626
Prob(F-statistic)	0.000131	0.000000	0.532101	0.000000	0.000000	0.000000

Notes: Each cell contains the estimated parameters, with Std. Error between brackets, where * denotes p-value of 10%, ** denotes 5% and *** denotes 1%

When splitting the whole research sample into 2 sub- samples homogenies, results support the effect of $LOGGB_{it}$ on banks' sector Capital Adequacy Ratio through Regulatory Capital to Risk-Weighted Assets (CAR) and Regulatory Tier 1 Capital to Risk-Weighted Assets (TICAR) in emerging markets with explanation power of 0.349672, 0.860873, respectively.

Simultaneously, results support the effects of green bonds on banks' sector Capital Adequacy Ratio through (CAR), (TICAR) and Profitability Ratio through (NIM_GI) in developed markets with explanation power of 0.500182, 0.561289, and 0.896792, respectively. So, for the first and second hypothesis, the null hypothesis is accepted and the alternative one could be rejected. This study reveals that the sector performance of banks in developed and emerging markets is significantly driven by green bonds.

The results indicate the positive impact of the green bonds on the Capital Adequacy Ratio (CAR) than Profitability of banks' sector in certain markets. The present results show that the Capital Adequacy of bank sector has increased in response to the investment in green bonds. The results reveal the significant impact of the green bonds on banks' sector Performance, most notably on the Capital Adequacy Ratio (CAR) side. Hence, results indicate that the green bonds can be used to predict bank sector' the Capital Adequacy Ratio (CAR) (more than Profitability) during 2013 to 2021.

6.3 Robustness Check for Endogeneity

In this study, the researcher conducted a number of robustness tests to ensure that the results were strong against alternative empirical specifications and possible biases. To check the robustness of the results, model diagnostics tests were performed, which proved that the impact significance of the green bonds on the performance of bank sector, most notably on the Capital Adequacy Ratio (CAR) side.

This study holds significance in the sense that LOG GB_{it} and GB_GDP_{it}, to measure the green bonds has been tested as a good predictor of bank sectors' Capital Adequacy Ratio (CAR) than profitability in developed and emerging markets. Therefore, considering the impact of one of financial derivatives side will help in the best understanding of financial institutions performance.

A Robustness check has been conducted to investigate the all-country effect, where this study considers the null hypothesis H_O: $\beta = 0$ versus alternative hypothesis Ha: $\beta \neq 0$, where β is the regression coefficient of the following functions:

$$Capital\ \widehat{Adequacy}\ Ratio_{it} = Constant + \beta_1 LOG\ GB_{it} + \beta_2 GB\_GDP_{it} +$$
$$\beta_3 GGNB\_GDP_t + \beta_4 GDPR_t + \beta_5 Inf._t + \varepsilon_{it} \tag{5}$$

$$\widehat{Profitability}_{it} = Constant + \beta_1 LOGGB_{it} + \beta_2 GB\_GDP_{it} + \beta_3 GGNB\_GDP_t +$$
$$\beta_4 GDPR_t + \beta_5 Inf._t + \varepsilon_{it} \tag{6}$$

6.3.1 Descriptive Statistics analysis

A descriptive statistic is used in this study to describe the object under study through data samples that have been processed by statistical test tools. All-Country effect has been considered; table (5) illustrates descriptive statistics of the research variables during the research period as follows:

Table 5: Descriptive Statistics analysis for 14 countries

Variable	N	Mean	Median	Minimum	Maximum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
CAR	126	16.69878	16.37506	12.18947	22.87453	2.677237	0.435990	2.504645	5.280051
T1CAR	126	14.19824	14.11505	9.275427	19.29162	2.429386	0.022628	2.335350	2.329993
NIM_GI	126	63.11311	66.28244	32.89117	82.78626	11.87042	-0.916627	3.039862	17.65265
GB	126	7.826406	1.546466	0.000000	85.30267	14.40358	2.777064	11.60599	550.7845
GB_GDP	126	0.279898	0.090754	0.000000	2.201513	0.471911	2.254756	7.406559	208.7056
GDPR	126	2.239135	2.237000	-10.82300	11.69000	3.950181	-0.806191	4.615035	27.34258
GGNB_GDP	126	-3.953183	-3.578500	-14.49200	8.395000	3.518527	-0.290384	4.233910	9.764085
INF	126	3.025627	2.101500	-2.074000	19.59600	3.364739	2.231346	9.522045	327.8767

Source: Outputs of data processing using EViews 10

6.3.2   The Regression analysis and hypotheses testing

All-Country effect has been considered, robustness check has been conducted by reprocessing data and provides the following results:

Table 6: Effects of green bonds on banks' sector in developed and Emerging Markets

Variable	CAR	T1CAR	NIM_GI
Constant	15.50542	13.18672	63.32688
	(0.674004) ***	(0.602675) ***	(3.321135) ***
LOG GB	1.845515	2.022488	-0.989282
	(0.376202) ***	(0.361378) ***	(1.434479)
GB_GDP	0.455209	0.254719	-3.566459
	(0.363707)	(0.349643)	(1.384271) **
GDPR	-0.091251	-0.104743	0.051260
	(0.032481) ***	(0.031246) ***	(0.123423)
GGNB_GDP	0.048989	0.046029	-0.120493
	(0.045005)	(0.043229)	(0.171631)
INF	0.142396	0.074219	0.246940
	(0.056517) **	(0.054141)	(0.216952)
R-squared	0.427960	0.444070	0.150656
Adjusted R-squared	0.404125	0.420907	0.115267
S.E. of regression	1.045340	1.008639	3.928213
F-statistic	17.95514	19.17093	4.257112
Prob (F-statistic)	0.000000	0.000000	0.001342

Notes: Each cell contains the estimated parameters, with Std. Error between brackets, where *denotes p-value of 10%, ** denotes 5% and *** denotes 1%.

For the whole sample, the results support the significance of $LOGGB_{it}$ effect on banks' sector the Capital Adequacy Ratios in all countries, with explanation power of 0.427960 and 0.444070, respectively. Addition to, findings provide the significance of GB_GDP_{it} effect on banks' sector Profitability in all countries, with explanation power of 0.150656.

Results provide that the banks' sector Capital Adequacy and Profitability Ratios in developed and emerging markets seem to be sensitive to green bonds measured by the LOG value of green bonds GB and the green bonds of GDP ratio (GB_GDP$_{it}$). The robustness test results show that there is a positive impact of the green bonds from 2013 to 2021 on the Capital Adequacy than Profitability of banks' sector in certain markets. Hence, results indicate that green bonds can be used to predict bank sector' Capital Adequacy (more than Profitability) from 2013 to 2021.

7. Conclusion and Recommendation for Future Work

The relatively recent green bond market is increasingly engaging interest at the practical and academic research levels, where the financial institutions interest to issue these financial derivatives to help transform the economy to green. This paper presents this contribution investigates the impact of green bonds on the banking sector performance annually from the onset of 2013 up to 2021 for 14 countries, focusing on developed and emerging markets.

Green bonds have been measured by the value of green bonds and the green bonds of GDP ratio, while the performance of banking sector is measured by capital adequacy and profitability. To examine the impact of green bonds on banking sector performance, this study focuses on developed and emerging markets, and includes the following 14 counties: developed markets (France, Germany, Italy, Netherlands, Spain, U.S., and UK) and emerging markets (Brazil, Chile, China, India, Mexico, Turkey, and UAE).

Using panel data, the findings indicate that there is a significant impact of the green bond on banking sector performance in in developed and emerging markets by capital adequacy ratios. Besides, the results provide that there is a negative impact of the green bonds on banking sector Profitability in these markets.

Overall, the results reveal the significant impact of green bond on the performance of banks' sector, most notably on the capital adequacy. This has to be more elaborated through further research to investigate the green bonds that may affect certain Stock market index and how do systemic risks react to the investment on green finance.

References

[1]   Alemzero DA, Iqbal N, Iqbal S, Mohsin M, Chukwuma NJ, Shah BA (2021) Assessing the perceived impact of exploration and production of hydrocarbons on households' perspective of environmental regulation in Ghana. Environ Sci Pollut Res 28(5):5359–5371.

[2]   Alonso-Conde, A-B and Rojo-Suárez, J On the Effect of Green Bonds on the Profitability and Credit Quality of Project Financing, Sustainability 2020, 12, 6695; doi:10.3390/su12166695. www.mdpi.com/journal/sustainability.

[3]   Danye, H. (2020) Research on the Impact of Green Credit on Profitability of Commercial Banks in China, E3S Web Conf., 214, 03008 DOI: https://doi.org/10.1051/e3sconf/202021403008.

[4]   Devine, A., & McCollum, M. (2021). Advancing energy efficiency through green bond policies. Available at SSRN 3856312.

[5]   Guo C-Q, Wang X, Cao D-D and Hou Y-G (2022) The Impact of Green Finance on Carbon Emission--Analysis   Based on Mediation Effect and Spatial   Effect.   Front.   Environ.   Sci.   10:844988.   doi: 10.3389/fenvs.2022.844988.

[6]   Hossain MA, Rahman MM, Hossain MS, and Karim MR. (2020). The effects of green banking practices on financial performance of listed banking companies in Bangladesh, Can. J. Bus. Inf. Stud., 2(6), 120-128. https://doi.org/10.34104/cjbis.020.01200128.

[7]   Iqbal S, Bilal AR, Nurunnabi M, Iqbal W, Alfakhri Y, Iqbal N (2021a) It is time to control the worst: testing COVID-19 outbreak, energy consumption and CO 2 emission. Environ Sci Pollut Res 28(15):19008–19020.

[8]   Li, W., Chien, F., Hsu, C. C., Zhang, Y., Nawaz, M. A., Iqbal, S., & Mohsin, M. (2021). Nexus between energy poverty and energy Environ Sci Pollut Res 1 3 efficiency: estimating the long-run dynamics. Resour Policy, 72, 102063.

[9]   Ning, Y., Cherian, J., Sial, M. S., Álvarez Otero, S., Comite, U., & Zia Ud Din, M. (2022) Green bond as a new determinant of sustainable green financing, energy efficiency investment, and economic growth: a global perspective, Environmental Science and Pollution Research ttps://doi.org/10.1007/s11356-021-18454-7.

[10] Quirici, M. (2018) The Increasing Importance of Green Bonds as Instruments of Impact Investing: Towards a New European Standardization "Social Impact Investments International Conference, Second Edition" Rome, 12-13 December 2018 - University La Sapienza (Italy), Conference paper.

[11] Song, X., Deng, X., Wu, R. (2019) Comparing the influence of green credit on commercial bank profitability in China and abroad: Empirical test based on a dynamic panel system using GMM, International Journal of Financial Studies, ISSN   2227-7072,   MDPI,   Basel,   Vol.   7,   Iss.   4,   pp.   1-16, https://doi.org/10.3390/ijfs7040064.

[12] Tomfort, A. (2023) Making Green Bonds Greener: Proposals to Increase the Efficiency of Green Bonds, Journal of Applied Finance & Banking 13 (1), 39-59.   Available at: https://doi.org/10.47260/jafb/1315.

[13] Yasmin, S. Akhter, I. (2021) Determinants of Green Credit and Its Influence on Bank Performance in Bangladesh, International Journal of Business, Economics and Law, Vol. 25, Issue 2 (December) ISSN 2289-1552.

[14] Yeow, K.E. and Ng, S.-H. (2021), "The impact of green bonds on corporate environmental and financial performance", Managerial Finance, Vol. 47 No. 10, pp. 1486-1510. https://doi.org/10.1108/MF-09-2020-0481.

[15] Yin, L & Wang, Q (2022) China's Green Finance Premium Anomalies Based on Factor Models Journal of Applied Finance & Banking, 12 (6), 57-76. Available at: https://doi.org/10.47260/jafb/1264.

[16] Zerbib, D. (2019). The effect of pro-environmental preferences on bond prices: Evidence from green bonds. Journal of Banking and Finance, 98. pp. 39-60. https://doi.org/10.1016/j.jbankfin.2018.10.012.

[17] Zhang, Y (2018) Green Credit Rises the Financial Performance of Commercial Bank--A Case Study on Industrial Bank, Advances in Social Science, Education and Humanities Research, 236 295 International Conference on Management, Economics, Education and Social Sciences (MEESS 2018) https://doi.org/10.2991/meess-18.2018.56 ISSN: 2352-5398.